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E04C 2/06

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(56) Documents cited
GB 2142674 A GB 2123048 A GB 1529909 A
GB 1425709 A US 4336676 A

(58) Field of search
UK CL (Edition K) E1D DCF DF116 DF193
INT CL⁵ E04C

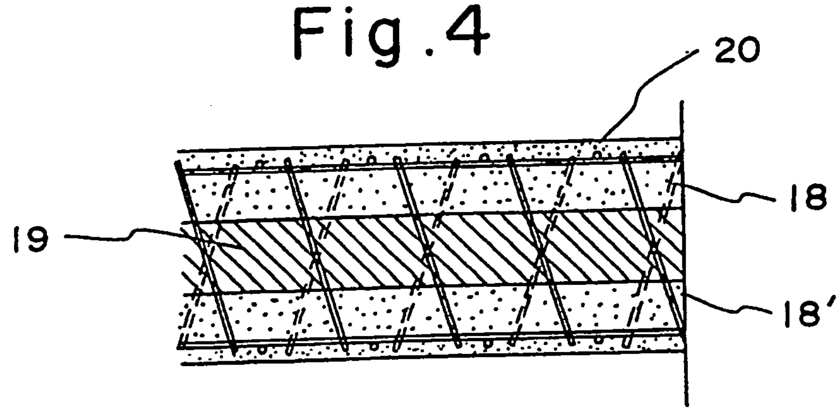
(54) Light-weight panel of wire mesh truss used as building wall element

(57) A light-weight building panel is made from two layers of wire mesh formed from wires and spaced a fixed distance apart by support ribs welded to the meshes to form a truss which is cut into lengths and these are laid in a molding frame and a mortar layer 18, 18' is formed on each surface; and between the mortar layers there is inserted a light-weight core 19, e.g. of a screen made of interwoven reeds, glass wool, cylindrical rods or bars, light-weight expandable mortar, straw and rice hull-filled cement.

Separators (27, 27', Figs 5 and 6) may be inserted orthogonally to the longitudinal direction of the truss so as to retain the cover material.

The panels can be used as indoor partition walls in buildings.

Fig.4



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The date of filing shown above is that provisionally accorded to the application in accordance with the provisions of Section 15(4) of the Patents Act 1977 and is subject to ratification or amendment.

Fig. 2

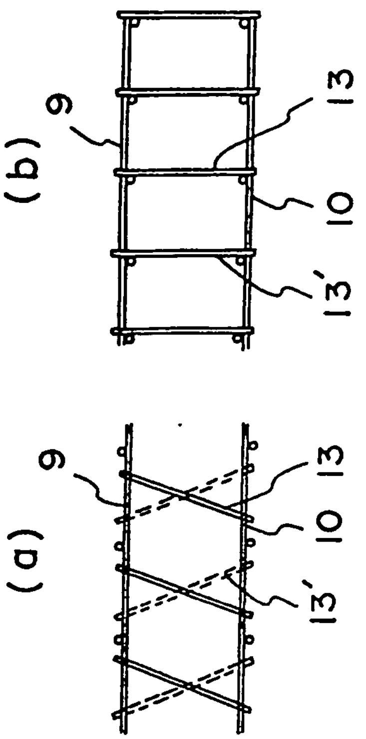


Fig. 1

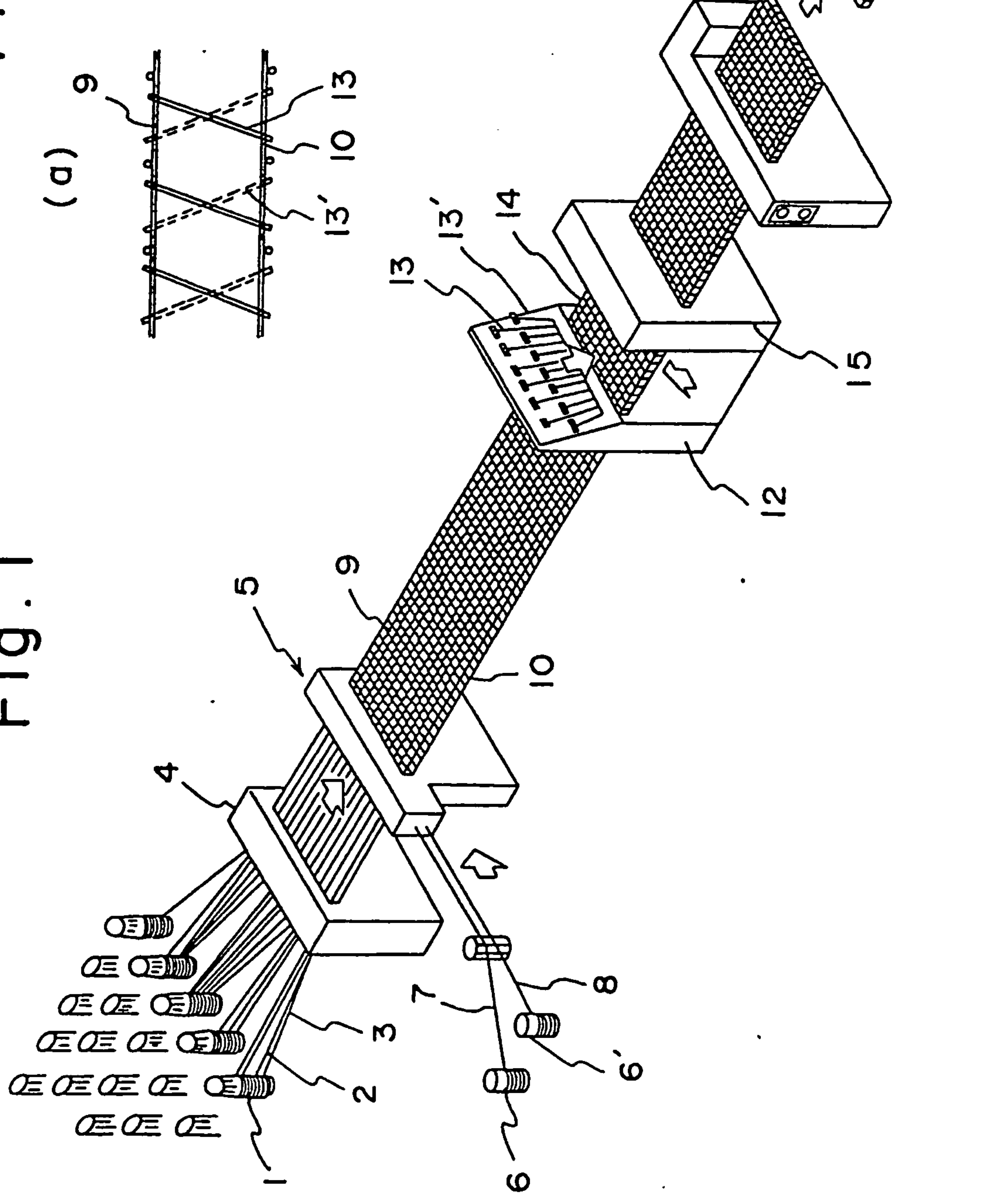


Fig. 3

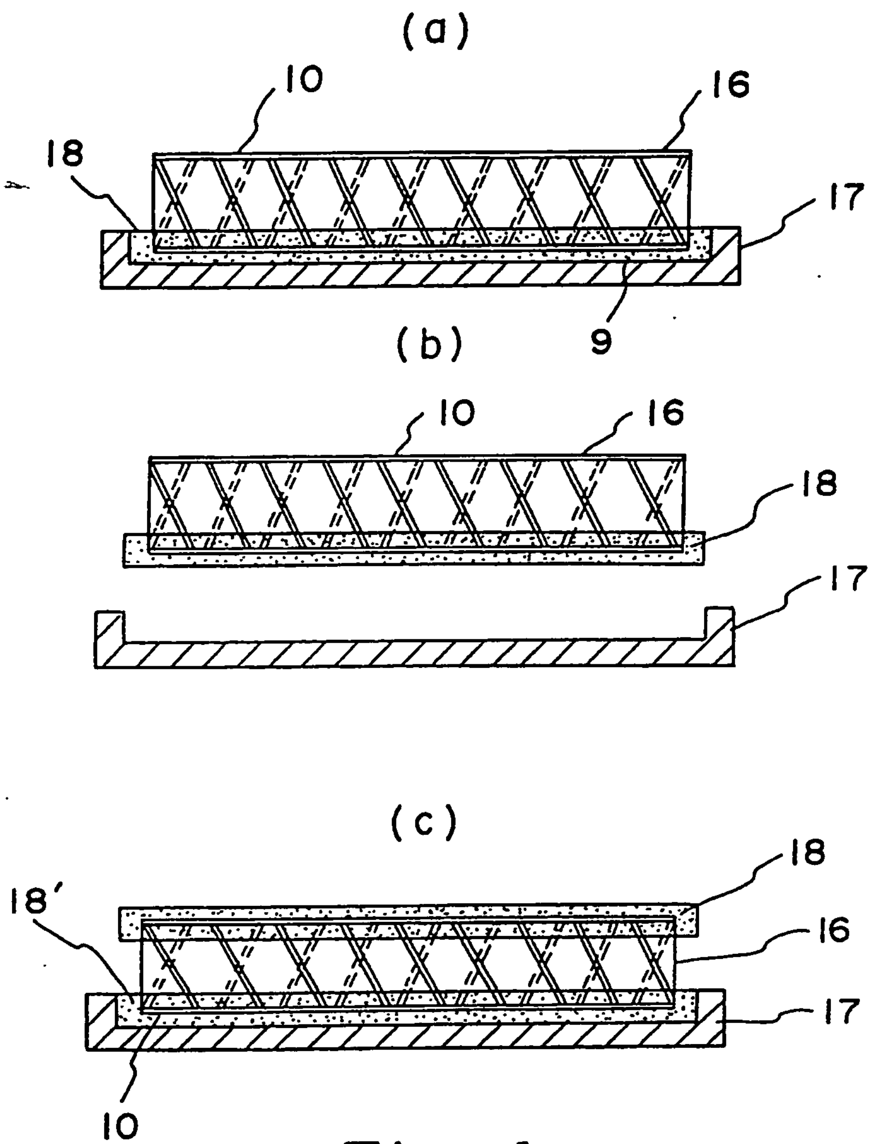


Fig. 4

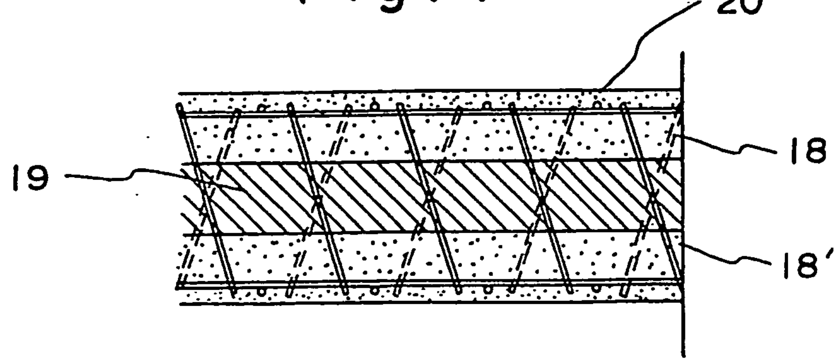


Fig. 5

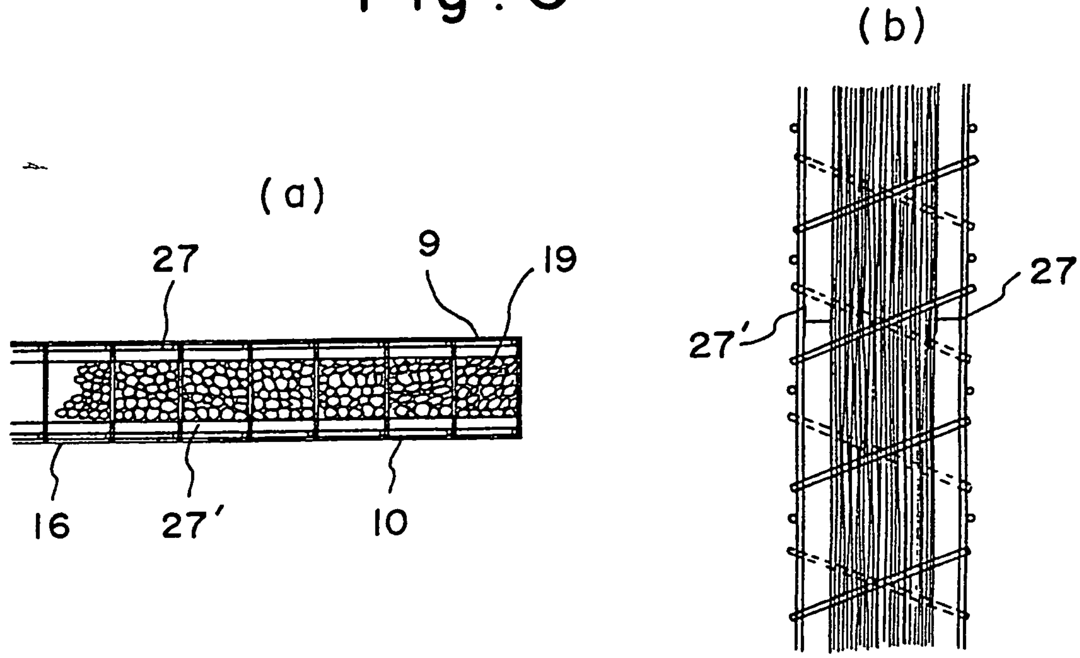


Fig. 6

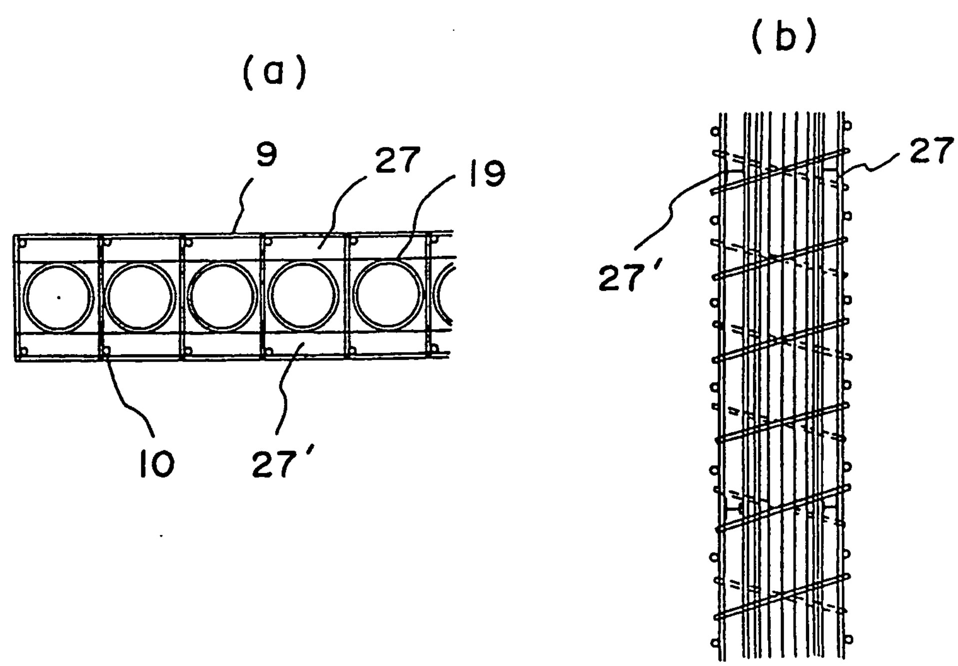
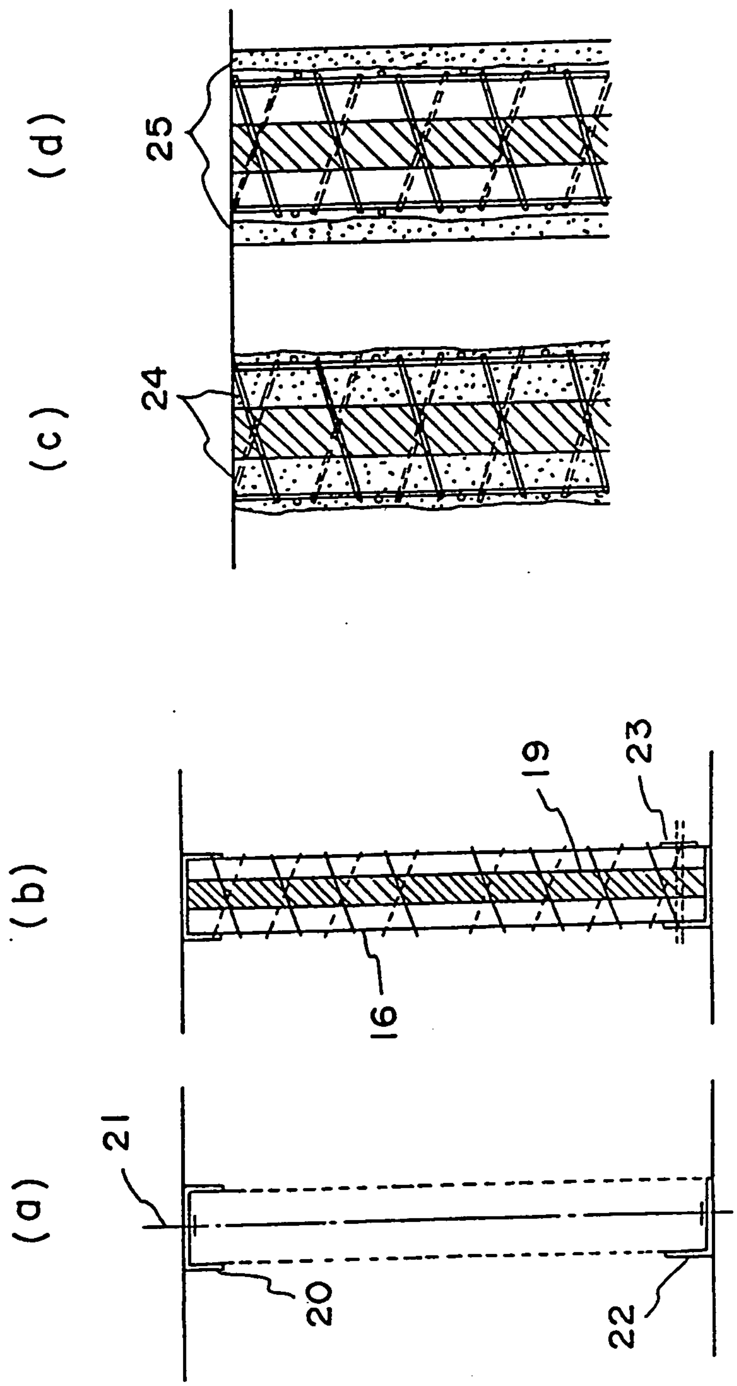


Fig. 7



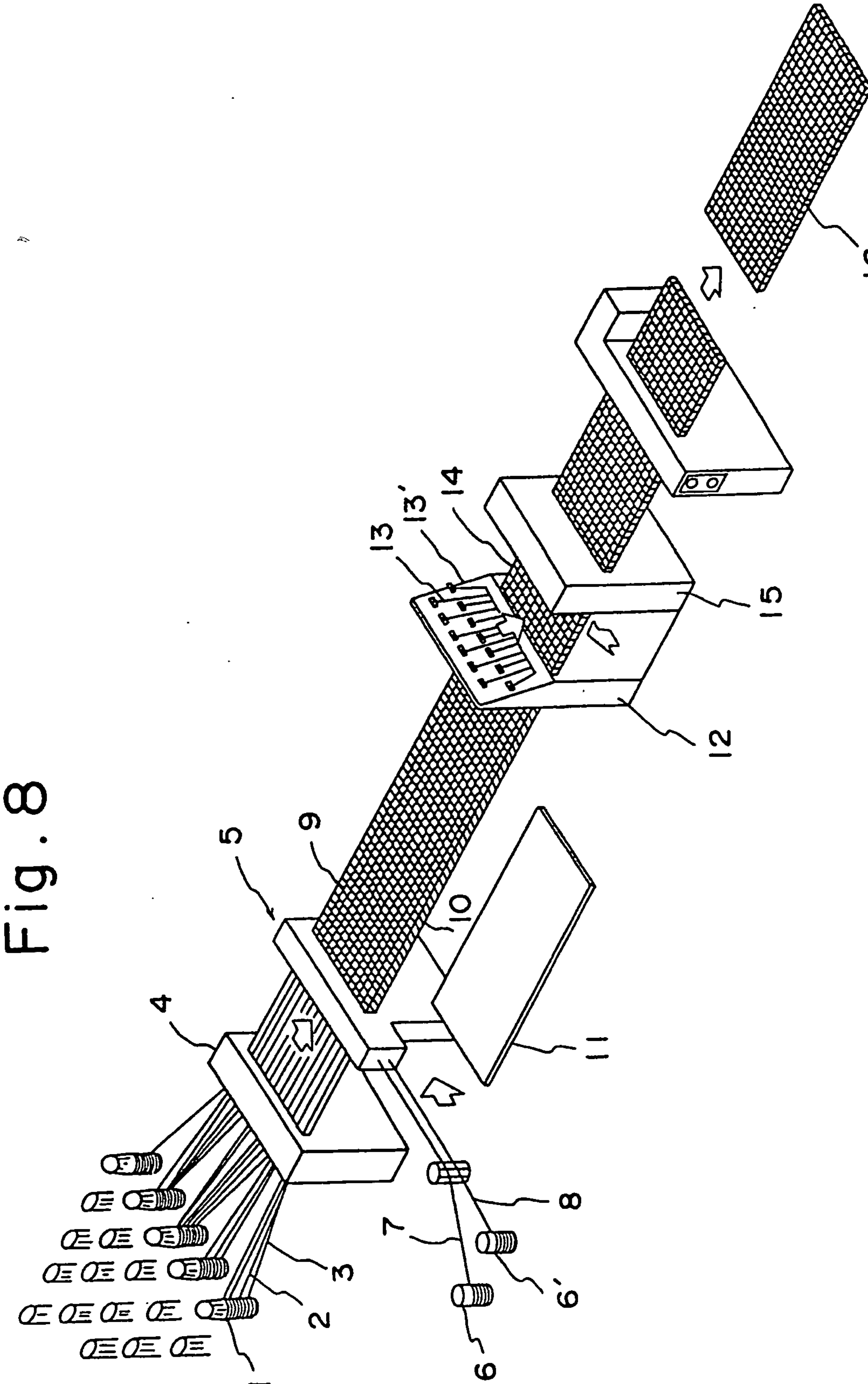
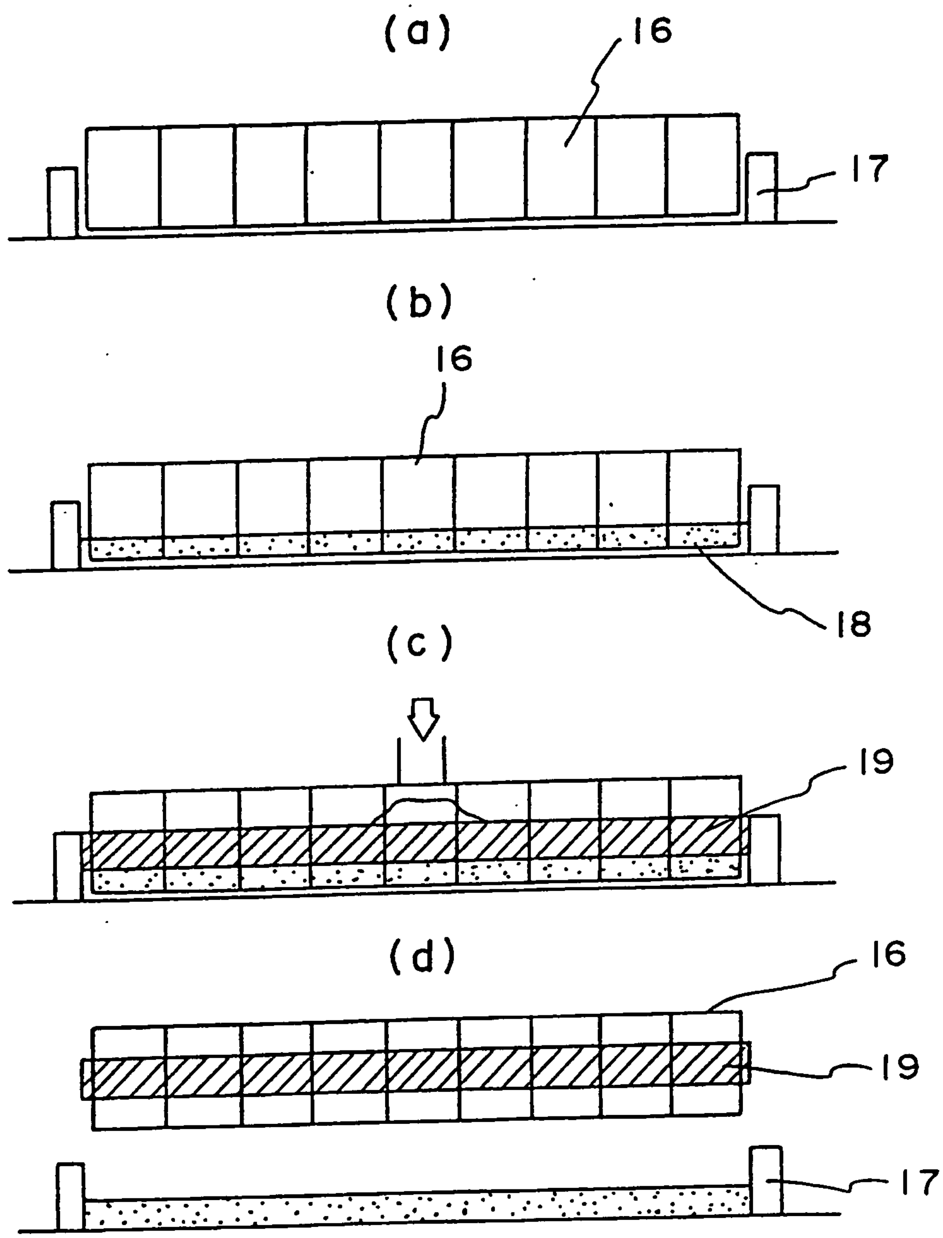


Fig. 8

Fig. 9



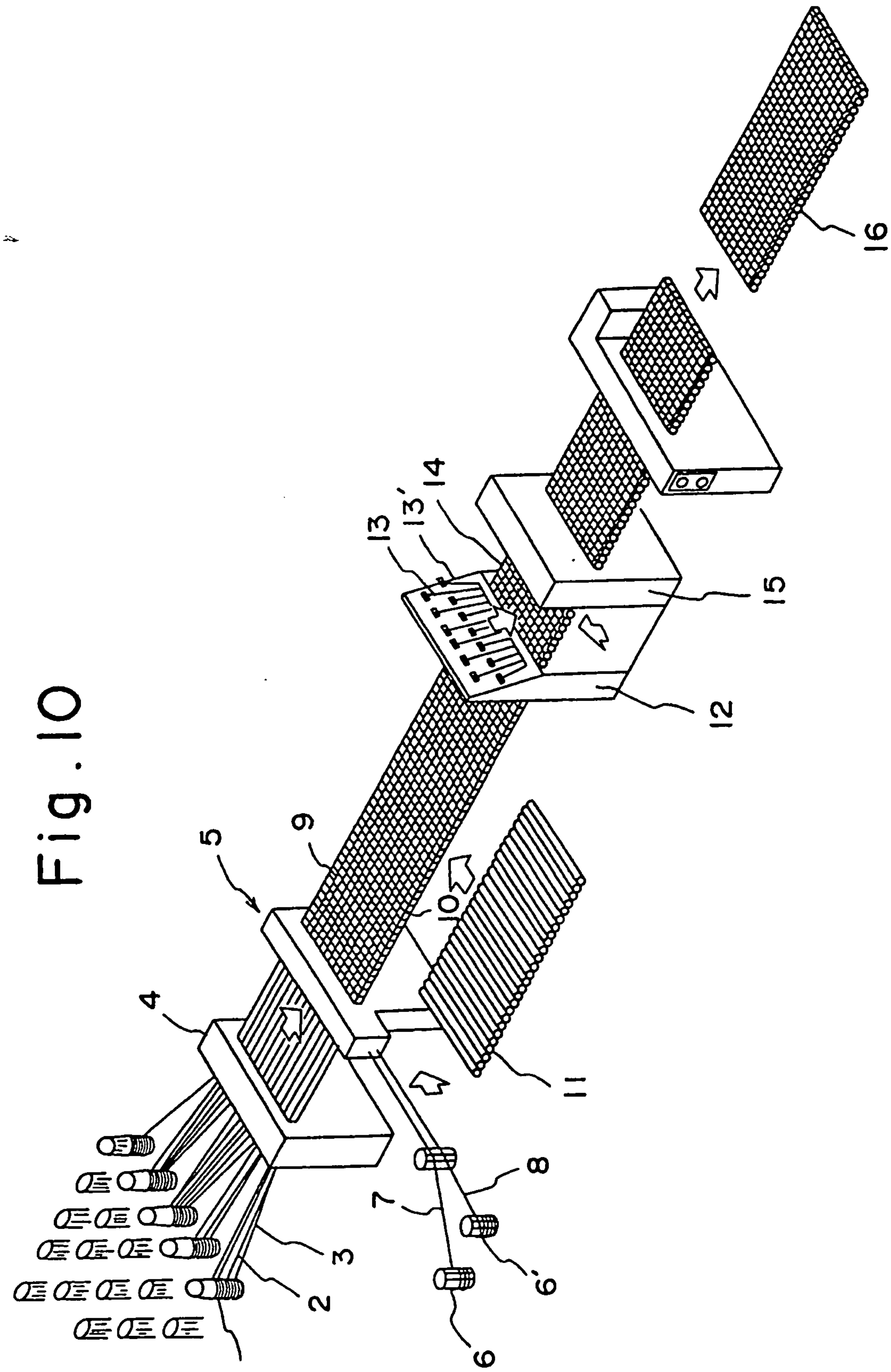


Fig.10

Fig. 11

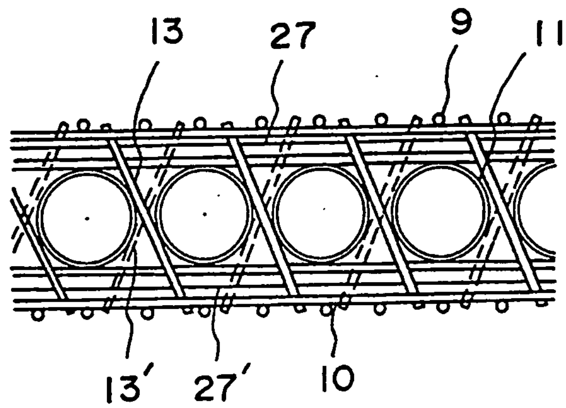


Fig. 12

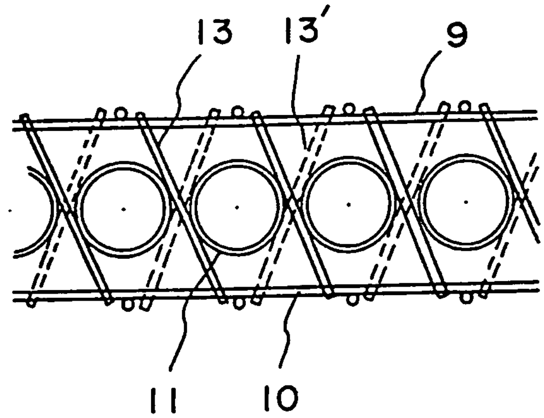
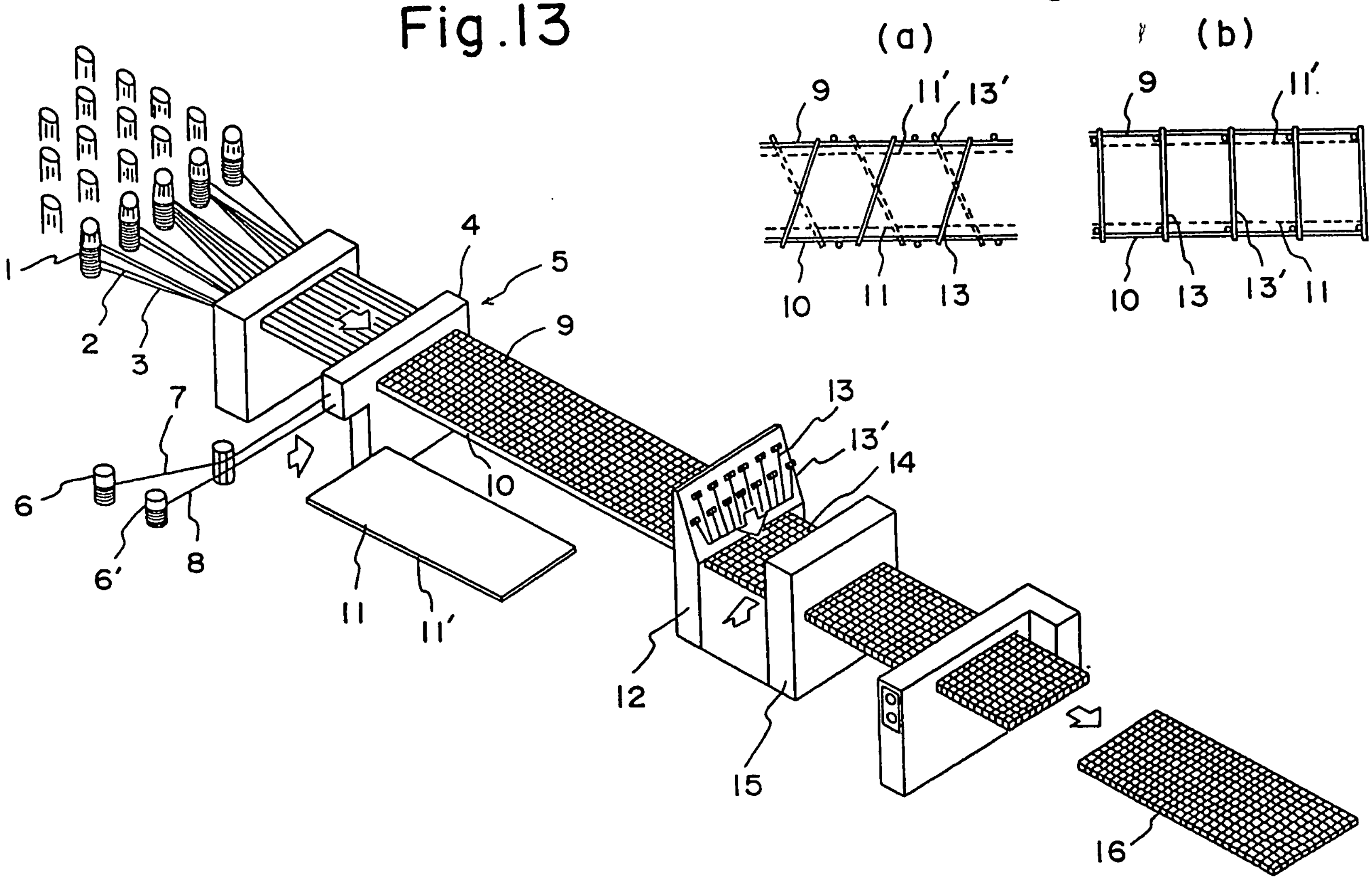


Fig.13

Fig.14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2
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12
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13'
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15
16
(a)
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13'
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11
13
(b)
9
11'
10
13
13'
11

Fig. 15

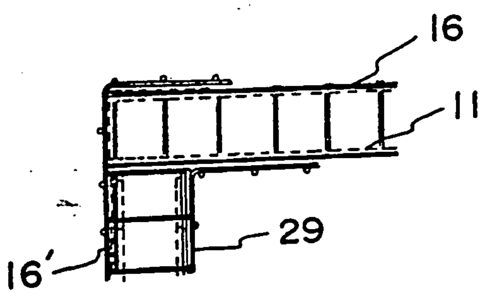

Fig. 16

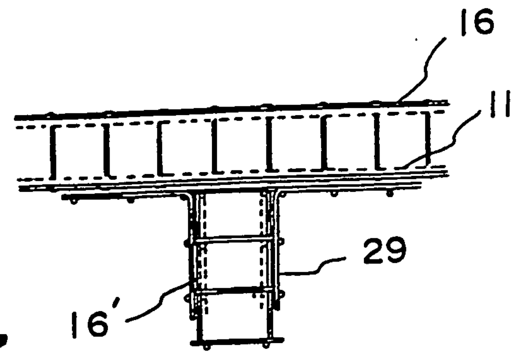

Fig. 17

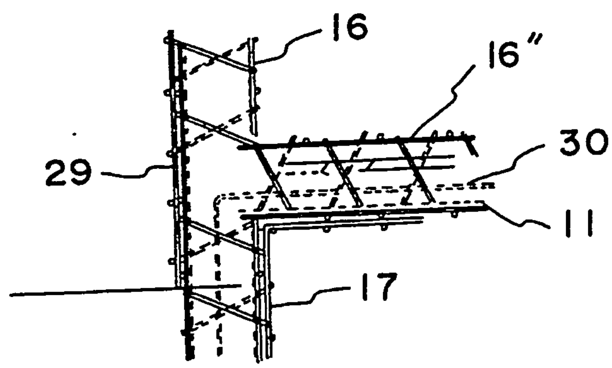

Fig. 18

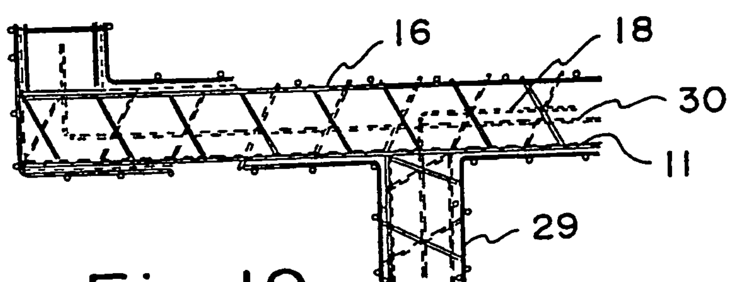

Fig. 19

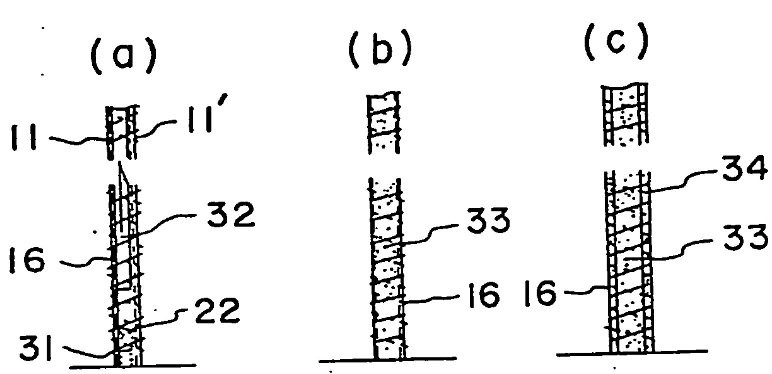

Fig. 20

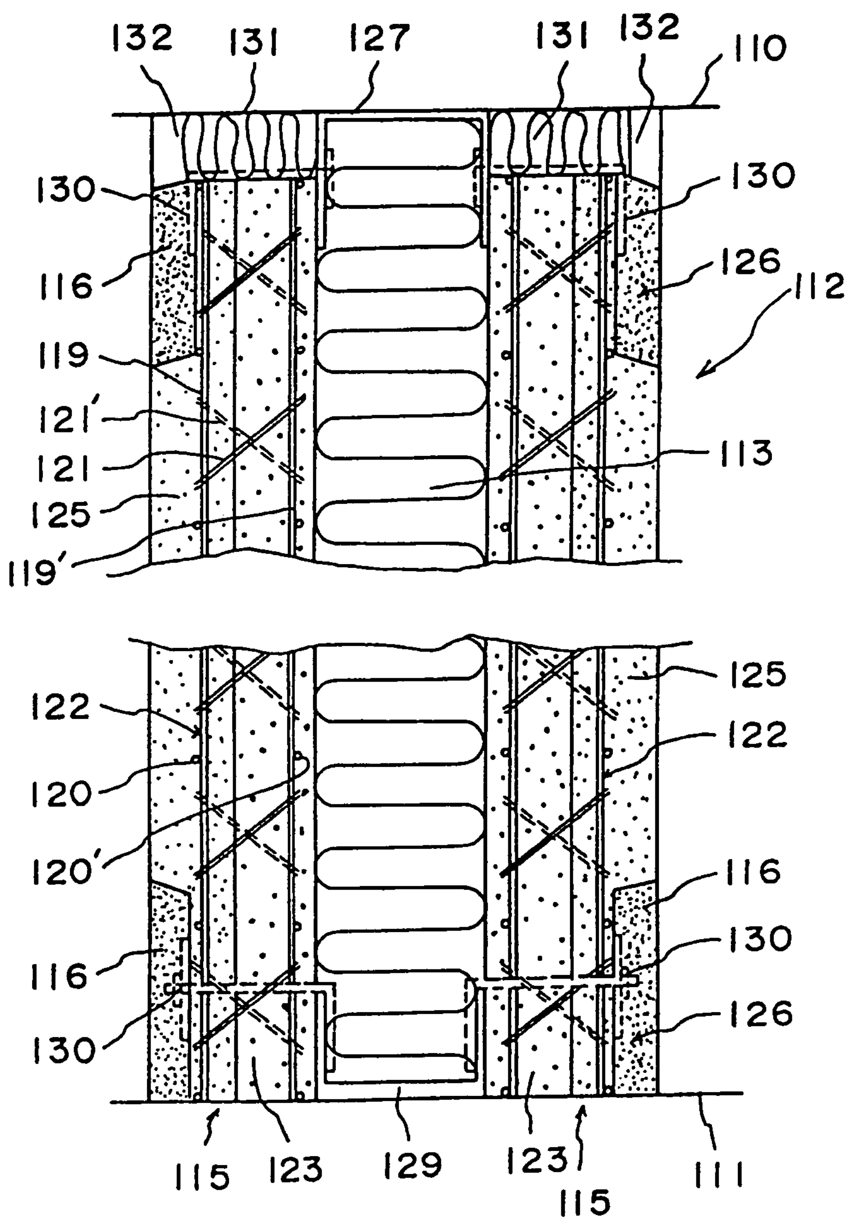
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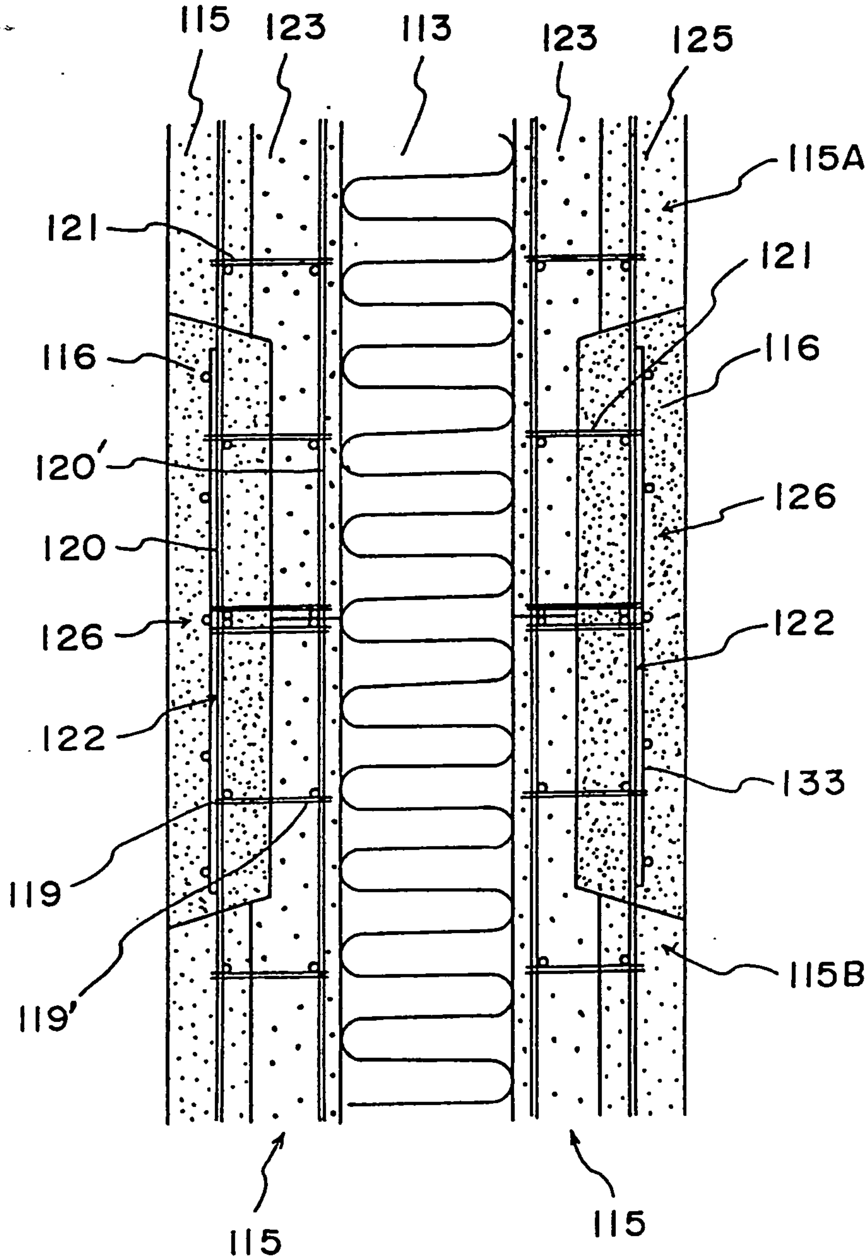
Fig. 21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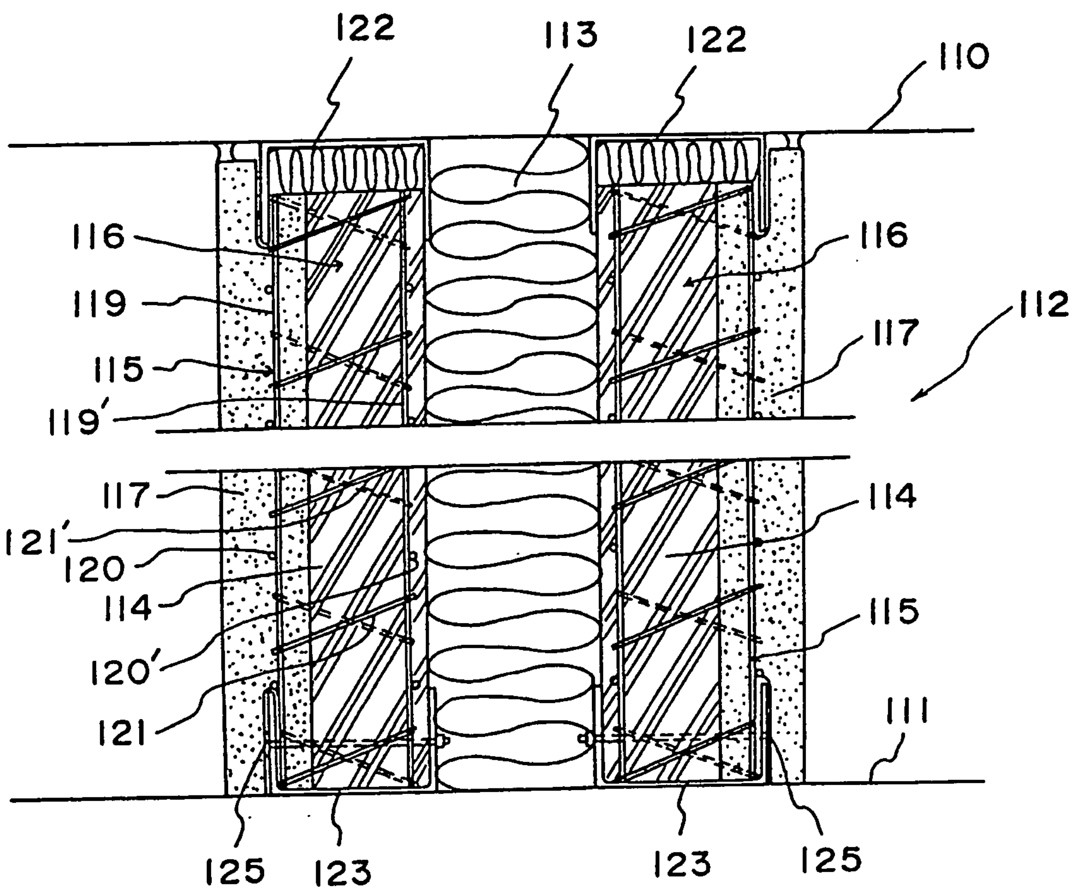
115

Fig. 22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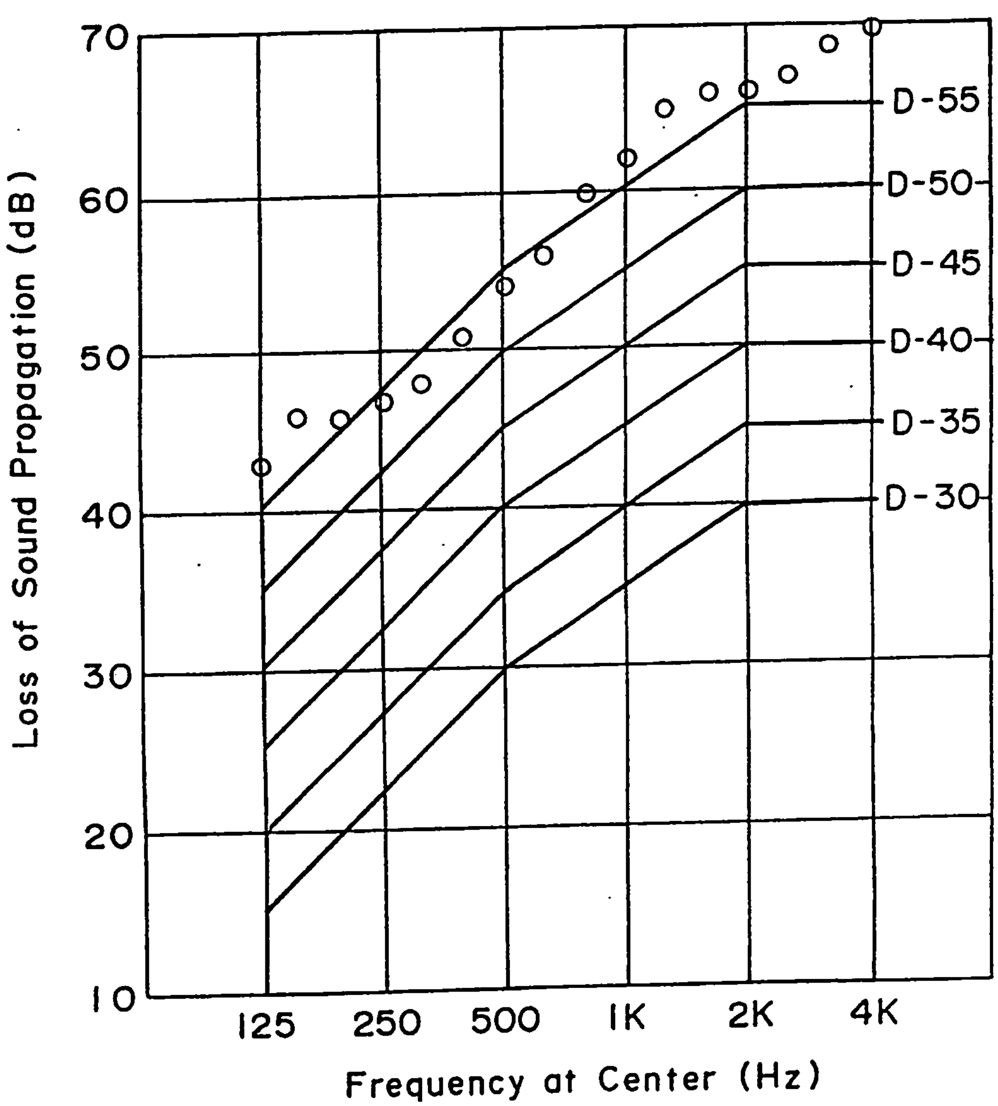
123
125

Fig. 23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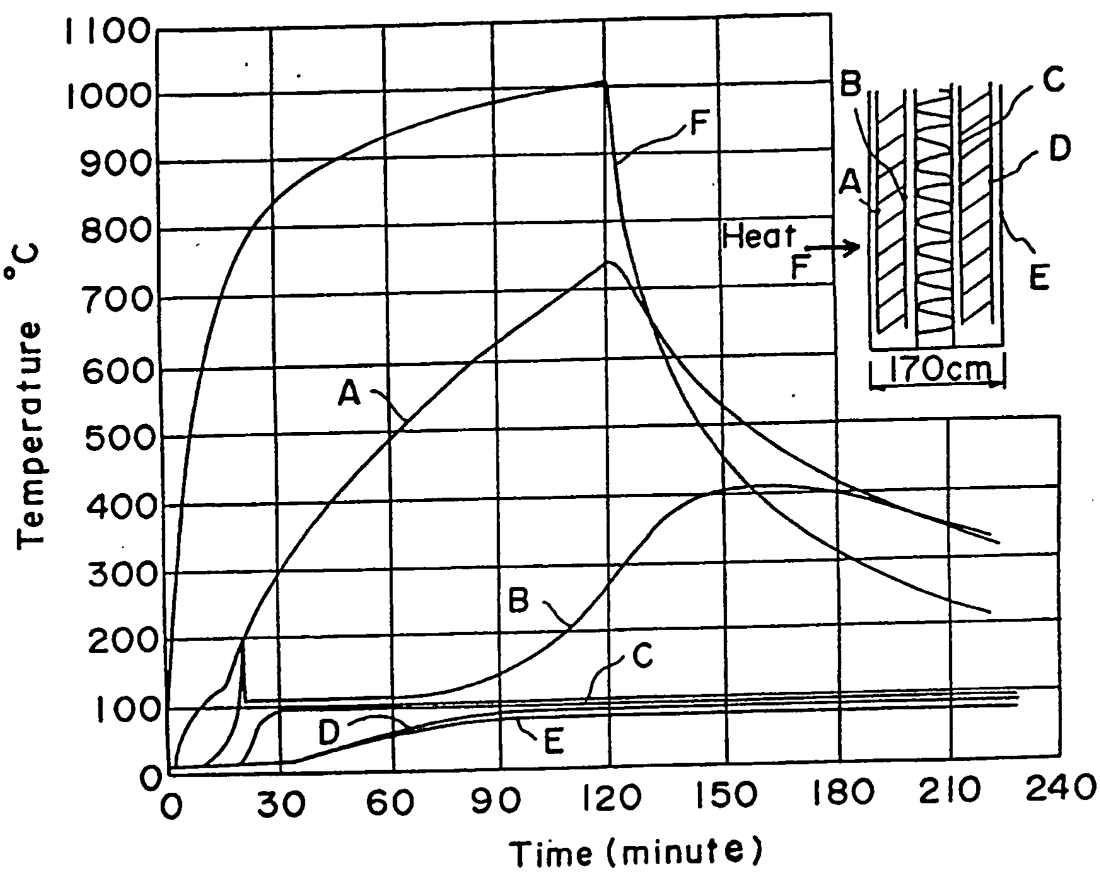
60
50
40
30
20
10
Loss of Sound Propagation (dB)
D-55
D-50
D-45
D-40
D-35
D-30
125
250
500
1K
2K
4K
Frequency at Center (Hz)

Fig. 24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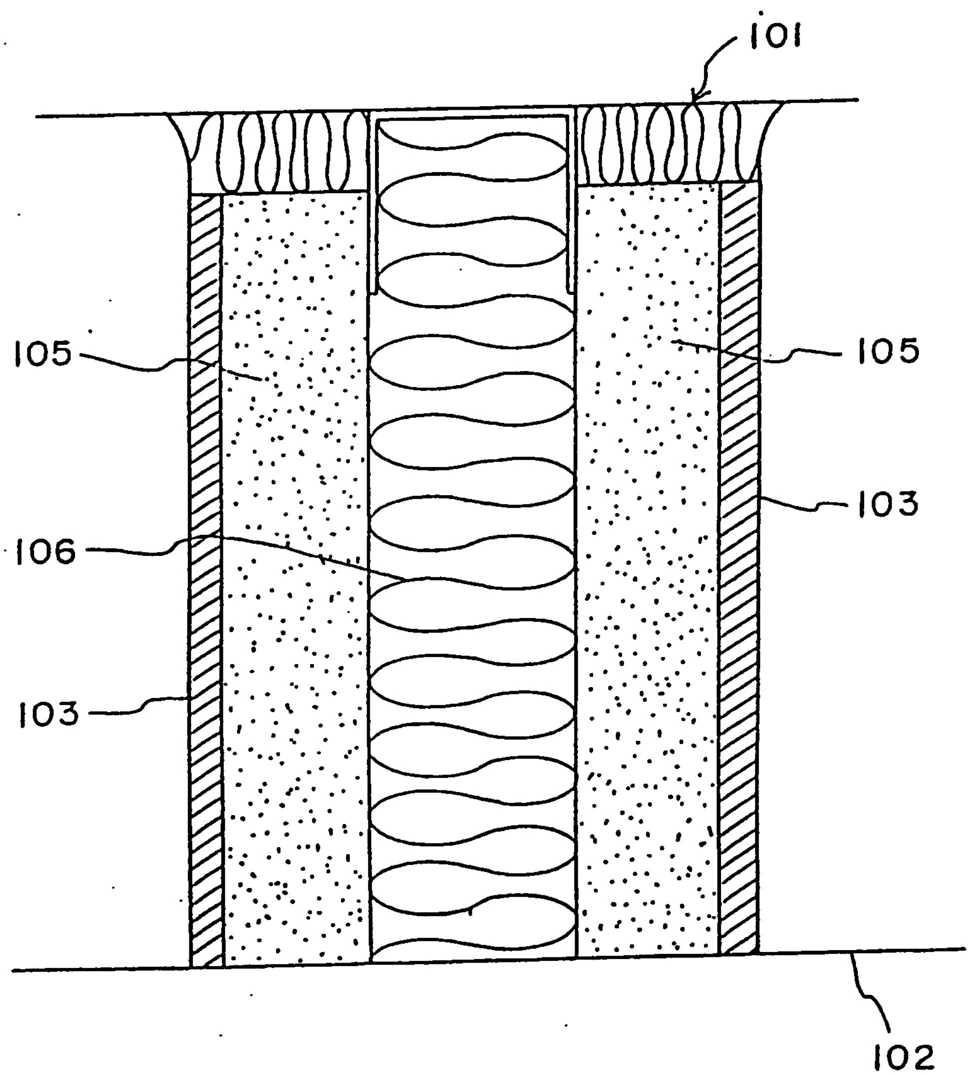
1000
900
800
700
600
500
400
300
200
100
0
Temperature °C
0
30
60
90
120
150
180
210
240
Time (minute)
A
B
C
D
E
F
Heat
170cm

Fig. 25



LIGHT-WEIGHT PANEL OF WIRE MESH TRUSS USED AS BUILDING WALL ELEMENT

This invention relates to a light-weight panel constituted of a wire mesh truss and used in indoor partition walls, one and two-story structures and walls, and to a method of making said panel, and of building therefrom a complex wall useful as a wall for dividing one apartment from another (hereinafter referred to as "dividing walls"), or as a partition wall requiring a sound-insulating property, which are primarily employed in high-rise apartment buildings.

The application is divided from Application No. 8625873 (GB-A-2196660), which claims wire mesh trusses and panels and their manufacture.

Precast (PC) panels, autoclaved light-weight concrete (ALC) panels and concrete blocks have long been used as materials for partition walls, buildings with few stories and walls. However, these materials generally are heavy and lacking in both sound-insulating and adiabatic properties. Hence there is a need for better building materials.

To this end, light-weight and strong building materials have recently been developed by combining a number of different expandable synthetic resins, and methods of building structures using these materials have been proposed. Specifically, structural panels are made by sandwiching a rectangular block of expandable light-weight plastic between grid-shaped reinforcement trusses, strengthening the mutual joints by application of pressure, subsequently placing ——————

supporting reinforcing bars across the reinforcement grids and welding the reinforcing bars to the grids. Alternatively, structural panels are made by arranging grid-shaped reinforcement trusses in parallel with a prescribed spacing therebetween, followed by placing supporting reinforcing bars across these trusses and welding the reinforcing bars to form a solid truss, and then forming a layer of expandable synthetic resin in the intermediate portion of the solid truss. In either case, the structural panels are carried to a construction site where they are erected into a structure at a predetermined location of a building. This is followed by the spraying of concrete at the site.

A "mesh molding frame" method of construction has also been proposed as an improvement on the conventional construction method based on pouring concrete in board-type molding flasks. Specifically, a metal underlay such as a wire net is affixed to both sides of a hollow net frame, concrete is poured in the interior and then a surfacing mortar is sprayed and set.

The conventional building materials such as the PC panels, ALC panels and concrete blocks have none of the prescribed properties mentioned above, namely the properties of light weight, sound insulation and thermal insulation. The structural panel obtained by combining the expandable synthetic resin and the

grid-shaped reinforcement trusses satisfies the requirement for light weight. However, since the method of fabricating the solid truss entails arranging a number of the grid-shaped reinforcement trusses in parallel side by side, laying columnar reinforcing bars across these trusses and then welding the same in order to obtain an integrated structure, manufacture requires both an extended period of time and machinery having a special mechanism and involving various process steps.

Specifically, to manufacture the solid truss, two parallel iron reinforcing bars are fitted into prescribed grooves in a die having grooves for receiving the positioned iron bars. Next, truss ribs of a prescribed length crossing the iron bars at a predetermined angle are dropped onto the iron bars and are precisely fitted into intersecting grooves on the die, after which welding is performed to form an integrated structure. Thus there is formed a single, continuous grid-shaped reinforcement truss composed of the two parallel iron bars and the truss ribs crossing these iron bars.

Next, the grid-shaped reinforcement truss is cut into predetermined lengths, a number of which are fed out in a state where they are juxtaposed in parallel. Supporting iron bars intersecting the whole of the two upper and lower parallel iron bars are laid across at right angles to the longitudinal direction and welding is performed from above and below to form an integrated

solid truss.

Thus, manufacturing the solid truss requires the use of a special die and employs means in which the manufacturing process is interrupted before the next process is begun. The result is poor manufacturing efficiency overall. Furthermore, with the "mesh-type molding" method of construction, the net frame of a support column generally is weak. Therefore, even if there are columns and beams, it is always required to build wall reinforcing bars into the net frame. High cost is the result.

Plans for high-rise apartment complexes generally call for construction of dividing walls and partition walls by a PC construction method using reinforced concrete, which is poured on site, or PC panels, ALC panels or concrete blocks serving as earthquake-resistant elements. However, these materials generally are very heavy, difficult to work with and costly.

With the recent trend toward ever taller buildings, it has become necessary to increase the non-load bearing capacity of dividing walls and lighten the same by a pure rigid frame structure, and various methods of constructing these dividing walls have been developed. More specifically, because of a reduction in weight at the upper part of buildings, simplification of the construction work and the use of large molding frames in high-rise apartment complexes, there is a trend toward reducing the weight of dividing

walls by fabrication after the construction of the building proper.

One example of the prior art is a dividing wall illustrated in Fig. 13. Two steel fiber-reinforced concrete panels 105, 105 each having a plaster board 103 adhered to one side are arranged to face each other in parallel relation at a dividing area between an upper floor 101 and a lower floor 102. A material 106 exhibiting excellent sound absorption, fire resistance and an adiabatic property, such as glass wool, is packed into the space between the panels 105, 105, thus constructing the dividing wall.

The conventional dividing wall employing these concrete panels is very heavy and difficult to handle. It also does not lend itself to labor reduction methods using robotization and is comparatively expensive. Moreover, the fact that the plaster board is adhered detracts from the durability and reliability of the dividing wall.

An object of this invention is to provide a light-weight panel using a truss as described above.

A further object of the invention is to provide a method of building a complex wall capable of being carried into a construction site in a simple and easy manner and assembled with ease, and which makes it possible to produce a dividing wall at low cost in a short period of time.

According to the invention we provide a light-weight panel constituted by a solid wire mesh truss comprising:

two layers of wire mesh spaced apart a prescribed distance;

support ribs joining said two wire meshes into a solid;

mortar layers sandwiching each of said layers of wire mesh; and

a core interposed between said mortar layers.

The light-weight panel of a solid wire mesh truss is manufactured by continuously forming two layers of wire mesh between which a predetermined spacing is maintained, forming the layers of wire meshes into a solid by joining them together by support ribs which are alternately different in a direction orthogonal to the longitudinal direction, cutting the solid to a predetermined length to form a solid wire mesh truss, sandwiching each of the layers of wire mesh between mortar layers, and inserting a core between the mortar layers.

The invention is illustrated by the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view showing a process for manufacturing a wire mesh truss as claimed in the aforesaid GB-A-2196660 and useful in making a panel of the present invention;

Fig. 2 is a side view of the configuration of support ribs in the wire mesh truss;

Fig. 3 is a side view of a process for forming surfacing mortar on both sides of a truss to make a panel of the invention;

Fig. 4 is a side view showing core material packed between the mortar coated truss of Fig. 3;

Fig. 5 shows plan and side views of a core placed in the middle of a truss;

Fig. 6 shows plan and side views of cylindrical core rods inserted longitudinally between separators othogonal to the longitudinal direction of a solid wire mesh truss;

Fig. 7 shows side views of a process for mounting a wire mesh truss with a core material between a slab of a ceiling, and for applying various layers of mortar;

Fig. 8 is a perspective view showing another embodiment of a process for manufacturing a wire mesh truss for use in the present invention;

Fig. 9 is a view of a process for forming a core in the middle of the truss;

Fig. 10 is a perspective view showing another embodiment of a process for manufacturing a wire mesh truss;

Fig. 11 is a side view of cylindrical frames inserted between parallel ribs and between provisional support bases of the wire mesh;

Fig. 12 is a side view of cylindrical frames serving as core members supported solely by intersecting ribs;

Fig. 13 is a perspective view showing another embodiment of a process for manufacturing a wire mesh truss;

Fig. 14 is a side view of the configuration of ribs in the truss as well as metal underlays extending between the two sides;

Figs 15 to 18 are views showing the assembled state of wire mesh trusses at various portions of a walled building;

Fig. 19 is a view showing a method of filling an assembled wire mesh truss with mortar;

Figs. 20 and 21 are respectively longitudinal and horizontal sectional views of a complex wall made from a truss;

Fig. 22 is a longitudinal sectional view illustrating another embodiment of a complex wall made from a truss;

Figs. 23 and 24 show graphs describing the results of experiments concerning sound insulation, heat resistance and thermal insulation; and

Fig. 25 is a longitudinal sectional view of a conventional dividing wall.

Figs. 1 to 7 illustrate a first embodiment of a truss usable in the present invention. A predetermined number of turntables 1 having steel wire wound thereon are arranged side by side and each pays out two upper and lower rows of wire 2, 3, as shown in Fig. 1. The paid out wires are arranged in lines and tensioned by a tensioner 4 and then enter a double mesh welding machine 5, where transverse wires 7, 8 from two turntables 6, 6' intersect the wires 2, 3 perpendicularly and are cut and welded thereto. Thus, two upper and lower layers of wire mesh 9, 10 are formed.

Next, the two layers of wire mesh are conveyed into a rib welder 12 where ribs 13, 13' are welded thereto, thus constructing a length of solid wire mesh truss 14.

The ribs 13, 13' can be arranged as shown in Fig. 2, namely inclined in mutually opposing directions, and alter-

nately inserted in a direction orthogonal to the longitudinal direction of the wire mesh truss, and the wire meshes 9, 10 and ribs 13, 13' are welded into an integrated body. Alternatively (not illustrated) different ribs 13, 13' can be inserted, so as to be arranged at positions that differ in the longitudinal direction, alternately in a direction orthogonal to the longitudinal direction of the wire mesh truss. The wire meshes 9, 10 and ribs 13, 13' are again welded together.

The length of wire mesh struss 14 is then fed to a cutter 15 where it is cut into predetermined lengths, each of which is a wire mesh truss 16.

As shown in Fig. 3(a), the wire mesh 9 on the one side of the single solid wire mesh truss 16 is embedded to an appropriate depth in a surfacing mortar filling a molding frame 17 having a depth equivalent to the thickness of the surfacing mortar to be provided on both sides of the truss.

Next, as shown in Fig. 3(b), the truss is removed from the mold after a prescribed period of curing and the above process is repeated for the wire mesh 10 on the opposite side, see Fig. 3(c). Thereafter, as shown in Fig. 4, a light-weight panel 20 is formed by inserting a light-weight core material 19 in the wire mesh truss 16 having mortar provided on both sides thereof as described above.

Suitable examples of the core material 19 are a screen made of interwoven reeds, glass wool, a cylindrical mold, light-weight expandable mortar, straw and rice hull-filled cement.

Figs. 5 and 6 illustrate ways of retaining the core material 19 in a panel of the invention.

As shown in (a) and (b) of both Figs. 5 and 6, separators 27, 27' are provided and arranged orthogonally to the longitudinal direction of the wire mesh truss 16, and the space between the separators is filled sufficiently by a screen of woven reeds. Since the truss 16 having the core material 19 thus formed is very light in weight, it can be carried into a building site in a simple manner without using a large transporter.

Next, for a case where the truss is to be used as a dividing wall, as shown in (a) to (d) of Fig. 7, a light iron channel 20 for fixing purposes is attached to a ceiling surface by being inserted or dry-fitted, across the centre of the wall position 21, and another light angle iron 22 for fixing purposes is fixedly secured to a ceiling at the slab position in a similar manner. The wire mesh truss 16 is then erected in these channels and is secured by fixing bolts 23.

Thereafter, as shown in Fig. 7 (c), a first layer of mortar 24 is applied by spraying, followed by the spray-application of a second layer of finishing mortar 25, as shown in Fig. 7 (d). To facilitate workability at the construction site, mortar can be sprayed on only one side of the truss in advance at the factory. The truss may then be transported to the site, installed between the ceiling and the slab and then

have its remaining side sprayed with the first and second layers of mortar 24, 25.

Figs. 8 and 9 illustrate another embodiment of the present invention. A core member 11 integrally molded into a plate-shaped configuration or a row of cylindrical molding flasks is inserted between the wire meshes 9, 10 and is retained by a supporting base. The two layers of wire mesh and the core member are conveyed to the rib welding machine 12 for having the ribs 13, 13' welded thereto, whereby the length of solid wire mesh 14 is formed. Even if the supporting base is removed, the core member 11 arranged in the wire meshes is retained sufficiently by the ribs intersectingly arranged on the inner side the wire meshes at predetermined positions without the core member 11 being specially welded.

The formation of the core member 11 is not limited to the foregoing method. Another method will now be described.

The method starts with the wire mesh truss 16 having the inserted ribs without the inclusion of the core member. As shown in Fig. 9(a), this truss 16 is set in a molding frame the depth whereof is equal to the thickness of the core member added to one-half a value obtained by subtracting the thickness of the core member from the thickness of the solid wire mesh truss. Then, as shown in Fig. 9(b), sand 18 is spread and leveled to attain a thickness which is one-half the

above value. Next, light-weight expandable mortar 19 is cast onto the spread sand 18, as depicted in (c) of Fig. 9. At this time the height to which the mortar is poured is made to coincide with the peripheral height of the mold 17. After the light-weight expandable mortar 19 cures, the solid wire mesh truss 16 is raised vertically in order to be removed from the mold 17, as shown in (d) of Fig. 9.

It should be noted that the core member 11 of the wire mesh truss 16 is not limited to the light-weight expandable mortar described above. It is also possible to use rice hull-filled cement kneaded together with a cement paste capable of being integrally molded into a flat shape on the spread sand.

Figs. 10 to 12 illustrate still another embodiment of the present invention. A row of cylindrical reinforcement rods 11 arrayed in a planar configuration are inserted between the wire meshes 9, 10 via provisional support bases 27, 27' of a predetermined height. The two layers of wire meshes are succesively conveyed into the rib welding machine 12 to have the ribs 13, 13' welded thereto, whereby the length of wire mesh 14 is formed.

The arrangement of the ribs 13, 13' is as shown in Fig. 11 and is the same as in Fig. 2. Even if the provisional supporting bases 27, 27' are removed, the row 11 of cylindrical rods is retained sufficiently by the ribs intersectingly arranged on the inner side of the wire meshes at predetermined positions.

The core number constituted by the cylindrical rods 11 is not limited to the above example. As shown in Fig. 12, the cylindrical rods can be inserted successively from the side between the intersecting ribs of the truss 14 emerging from the welding machine 12.

Figs. 13 to 19 illustrate yet another embodiment of a mesh for use in the invention. Two upper and lower metallic underlays such as wire netting 11, 11' (or only one of these underlays, namely the lower) are inserted between the wire meshes, 9, 10. The two layers of wire meshes are successively conveyed into the rib welding machine 12 where the ribs 13, 13' are welded thereto, whereby the length of solid wire mesh 14 is formed, and is cut into lengths 16 by cutter 15.

The ribs 13, 13' can be arranged as shown in Fig. 14, i.e. as in Fig. 2. Even if the supporting base is removed, the metal laths 11, 11' arranged on the inner side of the wire meshes are retained sufficiently by the ribs intersectingly arranged on the inner side of the wire meshes at predetermined positions without the laths being specially welded.

Alternatively, different ribs 13, 13' can be inserted in the direction orthogonal to the longitudinal direction, as described for the alternative to Fig. 2.

The truss 16 is carried in to the building site to form a so-called panel-type structure not having columns and beams. Figs. 15 to 18 show the various configurations.

The remaining Figures relate substantially to the trusses which are the subject matter of the aforesaid parent application, or to a mesh truss complex wall (Figs. 20-21) the subject of a copending divisional application.

CLAIMS:

1. A light-weight panel constituted by a solid wire mesh truss comprising:

two layers of wire mesh spaced apart a prescribed distance;

support ribs joining said two wire meshes into a solid;

mortar layers sandwiching each of said layers of wire mesh; and

a core interposed between said mortar layers.

2. A light-weight panel according to Claim 1 wherein said core is made of one or more of a screen made of inter-woven reeds, glass wool, cylindrical rods or bars, light-weight expandable mortar, straw and rice hull-filled cement.

3. A light-weight panel constituted by a solid wire mesh truss according to Claim 1 or 2, which also comprises separators arranged in a direction orthogonal to rows of the support ribs on the inner sides of said layers of wire mesh;

and the core is retained by said separators a prescribed distance from said layers of wire mesh on the inner sides of said layers of wire mesh.

4. A light-weight panel constituted by a solid wire mesh truss according to Claim 2, wherein said core is made of one or more of a screen of reeds molded integrally into a planar configuration, glass wool, light-weight expandable mortar, straw, rice hull-filled cement and a row of cylind-rical rods or bars.

5. A light-weight panel substantially as hereinbefore described with reference to any of the drawings and especi-ally Figs. 4 to 6, 9 or 11 to 12.

6. A method of making a light-weight panel which comprises continuously forming two layers of wire mesh between which a predetermined spacing is maintained, form-ing the layers of wire meshs into a solid by joining them together by support ribs which are alternately different in a direction orthogonal to the longitudinal direction,

cutting the solid to a predetermined length to form a solid wire mesh truss, sandwiching each of the layers of wire mesh between mortar layers, and inserting a core between the mortar layers.

7. A method of making a light-weight panel, substantially as hereinbefore described with reference to any of Figs 4 to 6, 9 or 11 to 12.

8. A wall made from panels as claimed in any of Claims 1 to 5 or made by the method of Claim 6 or 7.

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